Observations of Great Blue Heron *Ardea herodias* and Black-crowned Night Heron *Nycticorax nycticorax* and their Detrimental Effect on Nesting Habitat, Inkerman Migratory Bird Sanctuary, New Brunswick, 1971 - 2006

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ABSTRACT

Inkerman Migratory Bird Sanctuary, Inkerman, New Brunswick, Canada (47° 40' N 64° 47' W) was surveyed fifteen times between 1971 and 2006. The heronry consists of Great Blue Heron (GBH) *Ardea herodias* and Black-crowned Night Heron (BcNH) *Nycticorax nycticorax*. Based on ground counts, the GBH colony ranged from a low of at least ten nests in 1971 to a high of 81 in 1993. The GBH colony remained relatively stable from 1972 to 2006 (Mean = 58 nests, S.D. = 15, n = 11 ground census). The range in BcNH numbers has been more dramatic, being first reported present in 1971, ground counts have ranged from a low of 200 nests in 1987 to 601 in 1993 (Mean = 371, S.D. = 140, n = 7). The 2005 nest count is deceiving as the BcNH appear to have deserted the colony after nest initiation. The 36 year history of the colony, depicting habitat use and change, has been documented with the aid of aerial photographs (1963, 1971, 1985 and 2002) and survey notes. Habitat loss, predominantly tree death as a result of bird defecation and regurgitation, has had a major impact on colony stability; possibly resulting in an abandonment of the BcNH colony in 2005.

RÉSUMÉ

Le refuge d'oiseaux migrateurs d'Inkerman, à Inkerman (Nouveau-Brunswick) au Canada (47° 40' N. et 64° 47' O.), a fait l'objet de quinze relevés entre 1971 et 2006. La héronnière abrite le Grand Héron (GBH) *Ardea herodias* et le Bihoreau gris (BcNH) *Nycticorax nycticorax*. Selon les relevés au sol, la colonie de GBH a varié d'un minimum d'au moins 10 nids en 1971 à un maximum de 81 nids en 1993. Cette colonie est demeurée relativement stable de 1972 à 2006 (moyenne = 58 nids, écart-type = 15, n = 11 relevés au sol). La fourchette de population de BcNH a été plus large : l'espèce a été signalée pour la première fois en 1971, et les relevés au sol ont varié d'un minimum de 200 nids en 1987 à 601 nids en 1993 (moyenne = 371 nids, écart-type = 140, n = 7). Les résultats du relevé des nids effectué en 2005 est trompeur : le BcNH semble en effet avoir déserté la colonie après avoir construit ses nids. L'utilisation et l'évolution de l'habitat sur 36 années d'histoire de la héronnière ont été documentées à l'aide de photographies aériennes (1963, 1971, 1985 et 2002) et de notes de relevé. La perte d'habitat, surtout par la mortalité des arbres attribuable à la défécation et à la régurgitation des oiseaux, a eu un impact majeur sur la stabilité des colonies; il se peut qu'elle ait mené à l'abandon de la colonie de BcNH en 2005.

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INTRODUCTION

Colonial birds such as Great Blue Heron (GBH), *Ardea herodias*, and Black-crowned Night Heron (BcNH), *Nycticorax nycticorax*, are known to destroy the trees they nest in from the effects of guano and fish offal that emanate from their elevated nest structures. It is not certain which of these two substances is more deleterious; however, the end result is a dense spatter of this mixed material under the nest that eventually kills the supporting tree. Some tree species appear to be more resilient to this 'death by guano' and GBH and BcNH may also play a selective roll via their choice of nest site. In the Maritime Provinces of Canada, these birds tend to nest in remote areas such as offshore islands, peninsulas and remote woodland sites; removed from most disturbances. This specific habitat requirement, with the eventual destruction of nesting trees by the birds, results in a precarious existence exacerbated by increasing human development.

Highly visible large waders such as GBH, and to a lesser extent night foraging BcNH, are expected fauna of our wetlands. The general public can readily identify GBH and have an assumption that this species is very common; without much consideration of where, or under what conditions, they breed. In Nova Scotia, the first recorded nesting BcNH was on Bon Portage Island in 1977 (Quinney and Smith, 1980). In the early 1980s, 95% of New Brunswick's BcNH nested at Inkerman (Clayden *et. al.* 1984). By the mid 1980s, additional larger colonies, such as Caraquet Island, supported upwards of 100 nests (MacKinnon et. al. 1998d). However, as we will discuss, in 2006, no BcNH were nesting at either the Inkerman or Caraquet colonies while 754 nests were recorded at the recently expanded Lamèque colony (Personal Observations).

Great Blue Heron are much more abundant than BcNH and are more widely distributed in the Maritime Provinces; however, there are still relatively few colonies (Smith, 1980; Boyne and Hudson, 2002 and Smith *et. al.* 2006). Currently there are only 26 active heron colonies in the entire province of New Brunswick (Smith *et. al.* 2006).

Colonial birds tend to desert nests and even entire colonies if disturbed during the periods of pair-formation, nest construction or early egg-laying (Blaker, 1969; Jenni, 1969; Buckley and Buckley, 1978 and Tremblay and Ellison, 1980 *in* Bowman and Siderius, 1984). Much work has been done to determine the level of disturbance that herons can tolerate (Quinney, 1983; Vos, 1984; Vos, *et. al.*, 1985). Bowman and Siderius (1984, P. 4) provide a succinct summary of the issue, "Herons of all species are unpredictable in their response to the disturbance of a colony. The severity of the response does not always correspond to the magnitude of the disturbance, since even seemingly "innocuous" activities can produce serious results". Furthermore, "Herons inhabiting remote island or wooded locations that have experienced few disturbances are unlikely to tolerate human activities near their colonies" (Bowman and Siderius, 1984, P. 5).

Herons may abandon a nest due to habitat loss, from human development and encroachment, other disturbances or nesting tree mortality. The length of time before a change in nest location occurs is probably determined by a number of variables. One of which is the health, and thus nest holding capacity, of the supporting tree. If the colony is

in an area with an abundance of large trees, then birds locating an alternate nest site, should a few nesting trees die, may not be a problem. However, for colonies situated where habitat is limited the herons may eventually have to seek new nesting areas, at another location, or not breed.

The longevity of a heron colony at a particular site, often measured in decades, has important implications regarding options for habitat protection. Colony locations can and will change over time, thus sites secured today may not support herons in the future. Furthermore, some suitable nesting sites may not presently be used; however, if protected and left undisturbed, could provide valuable habitat at a later date. Often environmental assessments, in preparation for development in the vicinity of a heron colony, only take into consideration the current conditions; such as size, location and an appropriate buffer zone to protect birds from human disturbance. However, evaluating appropriate habitat outside the buffer zone, and making sure that it is protected, is not something that is currently considered or easily assessed.

The following observations pertain mostly to macro habitat changes within the heron colony at Inkerman Migratory Bird Sanctuary (MBS), Pointe aux Rats Musqués, Baie de Pokemouche, New Brunswick. Aerial photographs, periodic surveys, as well as detailed notes on colony configuration, provide an interesting case study on habitat degradation and loss at this heron colony. We show that heron induced habitat loss over the past 36 years, has reached a critical juncture in this colony's history.

STUDY AREA

Inkerman Migratory Bird Sanctuary is situated 2.5 km east of the village of Inkerman, on the Acadian Peninsula in northeastern New Brunswick, Canada (47° 40' N 64° 47' W) (Figures 1 and 2). Inkerman MBS is located on a wooded peninsula, Pointe aux Rats Musqués, bordered by salt marsh with Grande Anse to the northeast and Baie de Pokemouche to the southwest (Figure 2). The 15.1 ha sanctuary is located on private land; access is restricted (Figures 3 and 4). Inkerman was designated a Federal Migratory Bird Sanctuary, under the Migratory Birds Convention Act, on 20 October, 1998 (Appendix I).

The habitat consists of an overstory of White Spruce (*Picea glauca)* and Red Spruce (*Picea rubens*) with Red Maple (*Acer rubrum*), White Birch (*Betula papyrifera*), Balsam Fir (*Abies balsamea*) and lesser amounts of Trembling Aspen (*Populus tremuloides*) in the more open areas. The understory consists of dense thickets of Red Berried Elder (*Sambucus pubens*) and Raspberry (*Rubus* sp.) in the more open and decayed sections of forest. The remainder of the forest floor has a mixture of Wild Raisin (*Viburnum cassinoides*), Bunch Berry (*Cornus canadensis*) and Sarsaparilla (*Aralia hispida*) (Figures 5-7). The sanctuary is bordered by a Black Spruce (*Picea mariana*) and Sphagnum (*Sphagnum* sp.) bog to the north, salt marsh to the east and the shore of Baie de Pokemouche to the immediate southwest. The forested area extends to the northwest; however, this woodland is interrupted 0.5 km from the sanctuary by Route #113 and rural residences. Common and taxonomic names for plants follow Hinds (2000).

METHODS

The Inkerman MBS makes an interesting study of how GBH and BcNH have directly altered their nesting habitat. A comprehensive suite of aerial photographs (1963, 1971, 1985, and 2002), taken by the Province of New Brunswick, as well as fifteen colony surveys between 1971 and 2006, provide a story of habitat change and demonstrate how the birds have compensated for habitat loss. Two of these surveys were from the air while the remainder were ground counts (Table 1). Detailed information is minimal regarding surveys prior to 1993. It would appear that observations by H. Chiasson (1971, 1972, 1979, 1986 and 1987) may be estimates; however, details of the methodology are not recorded (Maritimes Nest Records Scheme, Canadian Wildlife Service, Sackville, N.B.). The ground survey by A. Smith (Canadian Wildlife Service, Sackville, N.B), in 1981, was conducted in a hurry because of concerns about the amount of disturbance they thought they might have been causing (unpublished survey record, Canadian Wildlife Service, Sackville, N.B.). No information pertaining to the shape of the colony, except for the colony location, was recorded during these early surveys. In concert with our ground surveys of 1993 to 2006, Boyne and Hudson (2002) conducted an aerial survey in 2000 and Eric Brideau (2001) conducted a ground survey on 13 August, 2001.

To build a more complete picture of habitat use and colony change, aerial photographs were analysed with the survey data and field notes to develop the following colony history. The past six surveys of the Inkerman MBS, from 1993 to 2006, have been conducted following similar and systematic methodology (MacKinnon 1993b; MacKinnon *et. al.* 1998a, 2000a, 2002, 2005a and 2006). Some changes in approach have been required due to the orientation and juxtaposition of the colony within the wooded peninsula. The surveys were conducted by running parallel transects through the narrowest width of the colony. Observers, usually four, walked abreast and within site of each other. The outward observers marked the flanks with red flagging tape. On completion of each transect, the group wheeled in unison such that on the next transect, the person who had been on the outermost flank now followed their recently marked line. One person, usually the crew leader, was identified as the recorder. The crew leader set the transect width, based on observer visibility and nesting density, and recorded observations relayed from the rest of the team. Observations by crew members were repeated by the recorder for confirmation. The crew leader also visually kept track of crew member observations to avoid duplication and/or missed nests. All movement within the colony was kept to a minimum with no sudden movement. Observations were passed by voice, but hand signals were used, when possible, to relay other information (e.g. direction, wait, proceed, etc.).

Nests of GBH and BcNH were differentiated in four ways:
1. Presence of bird on the nest;
2. Size of nest (GBH nests are roughly two to three times larger than BcNH nests);
3. Degree of nest spatter. GBH nests tend to have a larger volume and area of "white spatter" (bird defecation, regurgitated dead fish, etc.) on the ground under the nest; and

4. Location of nests (GBH nests are usually supported at or near the central trunk of the tree and not on outer, smaller, limbs).

Note that some recorders in the past only enumerated 'number of nests' while not making a distinction if the nest was occupied or not. In more recent surveys, we have made the distinction between 'occupied' and 'un-occupied' nests. Occupied nests show evidence of activity, such as guano spatter (below the nest on the ground), as well as presence of an adult bird, egg and/or chick. Un-occupied nests did not show evidence of spatter, or contain an adult bird, egg or chick.

Maps were prepared showing the orientation and juxtaposition of the colony during each survey. Where the colony was clearly divided or there was a 'sub-unit', this was noted and separate records were maintained for each component. General information regarding vegetation, habitat use and other wildlife was also recorded.

RESULTS AND DISCUSSION

Inkerman MBS was surveyed fifteen times between 1971 and 2006 (Table 1); including two surveys conducted in 1979 and both a ground count and aerial survey conducted in 2000. All the surveys were from the ground except for aerial surveys in 1979 and 2000.

Great Blue Heron build substantial nests and require supporting vegetation of appropriate rigidity. Nests, usually only one or two per tree, tend to be in spruce or fir. However, on islands, such as Bay du Vin, New Brunswick, multiple nests of GBH are often found in large White Pine (MacKinnon *et. al.*, 2005b). In contrast, BcNH make remarkably small nests, such that one wonders how they can support eggs for incubation. The BcNH nests at Inkerman, sometimes many per tree, are frequently found in hardwoods, such as Red Maple, White Birch and Trembling Aspen (Figures 5-7).

The 1963 aerial photograph of Pointe aux Rats Musqués (Figure 8) shows the future site of the Inkerman GBH and BcNH colony. The habitat consists of a typical coastal mixed forest, flanked by a Black Spruce and sphagnum bog to the northeast, a salt marsh to the southeast and a long rectangular field, which is apparently still under cultivation, immediately to the west. Active farming of this field would likely have discouraged GBH and BcNH from nesting in the adjacent woods.

The earliest surveys by H. Chiasson show a rapid increase in Great Blue Heron presence from at least 10 nests in 1971 to 70 nests just one year later. In 1979, H. Chiasson recorded 75 GBH nests but no BcNH, while just two years later A. Smith estimated 115 nests of GBH and between 575 and 700 nests of BcNH.

In 1971 (Figure 9) the habitat looks relatively unchanged since 1963. The field appears to be no longer under cultivation and this diminished 'disturbance' coincides with the first reported nests of GBH (10+ nests) and presence of BcNH by H. Chiasson (Table 1).

The aerial photographs, from 1985 (Figure 10) and 2002 (Figure 11) depict a marked habitat change at the colony's core over this 18 year period. While dead and dying trees are noticeable in the 1985 photo, by 2002 a large and expanded area is largely devoid of trees with a few standing dead spruce remaining in the southwest corner.

More detailed ground surveys at Inkerman MBS began in 1993, where colony juxtaposition, as well as vegetation characteristics, were also recorded. The 1993 data, as well as information from surveys in 1998, 2000, 2002, 2005 and 2006 have been superimposed on the 2002 aerial photograph to track changes in the colony (Figures 12-16). The GBH colony size has remained relatively consistent from 1972 to 2006 (40 – 81 pair, excluding estimates and aerial surveys, n = 11 ground census, mean 58, S.D. 15) with outward expansion as the core trees were killed off. However, ground census numbers for BcNH have ranged much greater than that for GBH (1986 – 2002, Mean = 371, S.D. = 140, n = 7). From an apparent rapid colonization/expansion by BcNH in 1981 (estimate of 575 – 700 nests), the colony remained large from 1993 to 2002 with abandonment by 2005 or 2006 (Table 1). A summary of changes in the size of the colony from 1993 to 2006, as compared to colony shape as a result of tree loss, follow.

During the 1993 survey, the heron colony was shaped like a 'doughnut' (Figure 12). The centre was devoid of nests and consisted of a tangle of fallen, criss-crossed, spruce and fir hidden within a lush growth of raspberry and elderberry. The 'ring' of the doughnut (Figure 12, Area A) consisted of standing spruce, fir, red maple and birch. The colony consisted of 81 nests of GBH and 601 nests of BcNH. The GBH were mostly in the spruce and fir while the BcNH were in various species of deciduous trees. Evidently the hole of the doughnut was the site of the initial colony in, or before, 1971.

By 1998 (Figure 13) the nesting trees at the northeast to southeast side of the 'doughnut' had been killed by nesting herons. The remaining colony (Figure 13, Area B) was restricted to a wooded area to the southwest of the original colony core; flanked to the west by the rectangular field. Outside Area B, a few GBH still remained nesting in very fragile and derelict spruce to the northwest of the core (Figure 13, Area C).

In 2000, the trees in area C (Figure 13) had collapsed and all of the GBH and most of the BcNH were restricted to area D (Figure 14) while a few BcNH were nesting in what would appear to be sub-optimal habitat in a narrow fringe of shrubs in area E (Figure 14) between the old colony core and the saltmarsh.

By 2002, the available nesting habitat in area E (Figure 14) was exhausted and the main colony was restricted to the same area as occupied in 2000 (Figure 15, Area F). As nearly all of the large nesting trees, especially for the GBH, were severely limited, a small sub - colony (Figure 15, Area G) had re-located to a stand of large, healthy spruce just north of the old colony core.

In 2005, some of the GBH were still nesting in area H (Figure 16), although more than half (56.8%, n = 51) of the birds had moved and quickly expanded into what may be the last available stand of suitable spruce and fir (Figure 16, Area I). As can be seen on the

2002 aerial photograph, the remaining area of suitable nesting habitat for GBH is becoming limited. If the size of the GBH colony remains relatively stable and other factors remain the same, there should be suitable nesting habitat for possibly another 20 or 30 years before the remaining nesting trees are killed.

Great Blue Heron have been known to nest on the ground, such as the cliffs at Margaree Island National Wildlife Area (MacKinnon, 2000b) and the small rocky island within the Haley Lake MBS (Tufts, 1986); both sites located in Nova Scotia. However, both of these areas are isolated from most mammalian predation and nesting numbers are small. It is very doubtful that ground breeding attempts by herons, at sites such as Inkerman, would be successful where mammalian predators are present.

Although suitable nesting habitat remains for GBH, such as spruce and fir, there appears to be a decline in BcNH habitat. The recent area of colony expansion (Figure 16, Area I) is composed mostly of spruce and fir; tree species that have less frequently been used by BcNH at Inkerman. This loss of available nesting habitat has possibly resulted in the abandonment of the BcNH colony. Although 174 nests were recorded during the 2005 census, only four adult BcNH were observed in the immediate area and only one of these four birds was observed within the colony. Although BcNH nest are small, of rather flimsy construction, and tend to be located on the outer branches of hardwood tees (Figure 6), some of these nests do survive over winter (Andrew Macfarlane, pers. comm.) and thus some empty nests recorded in 2005 could have been built the previous year. Black-crowned Night Heron usually return from their wintering grounds in early April, and as the census was conducted on 2 June, 2005 we believe that at least some birds initiated nest construction early that year and then, for some at present unknown reason, abandoned the colony.

The most recent survey (7 June 2006) recorded 45 occupied nests of GBH and no active BcNH nests. However, 82 empty BcNH nests, apparently surviving from previous years, were noted (Table 1). For GBH, Area H (Figure 16) contained 18 nests, of which 11 (61%) were occupied; an additional 7 nests had fallen to the ground. However, Area I contained 35 nests of which 34 (97%) were occupied and no fallen nests were noted. It would appear that within a few short years, there will be no suitable trees left in Area H to support GBH nests. Area I presently has the healthiest trees and supports 34 of 45 (75.6%) of the occupied nests.

So where did the BcNHs go? In 1993 there were reports of illegal activity within the colony where up to 40 birds were indiscriminately shot. Large mammals such as moose frequent the site; as evident by the abundance of browse and droppings and a pair of Great Horned Owl have been observed, with young, on nearly every visit. The shooting event in 1993 has to the best of our knowledge not been repeated and the site use by moose and Great Horned Owl, while undoubtedly a stress to the herons, is not thought to be responsible for the recent abandonment. Nelson Poirier (pers. comm.) reported that BcNH had vacated the Inkerman colony by 7 July, 2004 and did not return that year. Also, throughout the summer of 2005, Lewnanny Richardson (pers. comm.) reported small numbers of roosting herons (upwards of 20 GBH and 4 BcNH) on the wooded

peninsula/island at Pointe-à-Bouleau located about 20 km south of Inkerman MBS (Figure 1). Boyne and Hudson (2002) reported 20 pairs of GBH nesting at Pointe-à-Bouleau in 1991. The construction of a canal, approximately six years ago connecting Tracadie Bay with Big Tracadie River, through Pointe-à-Bouleau, has created an island out of the peninsula. The newly created island is vegetated with low mixed woods and would appear suitable for herons to nest. There has been some suggestion that a portion of the Inkerman BcNHs may have relocated to Pointe-à-Bouleau; however, these observations are at present unsubstantiated.

A more comprehensive survey of the larger heron colonies along eastern New Brunswick was conducted by the authors in 2006; partly in an attempt to relocate the missing BcNHs from Inkerman. On 5 June, 2006 we recorded a very large colony (754 nests) of BcNH at Lameque, New Brunswick (the colony site was known, but the BcNH colony size was believed to be only around one hundred nests) (Figure 1). Due to the size of the colony, presence of mobile BcNH chicks and wish to minimize survey time, the surveyors only recorded total BcNH nest (occupied and un-occupied). Based on the number of adult birds, we believe a majority (> 95%) of the 754 BcNH nests were occupied. In the absence of marked birds, this concentration of nesting BcNH at Lameque, only 15 km north of the Inkerman colony, is likely where the Inkerman birds have relocated.

CONCLUSION

What can be learned from the Inkerman example? Colonial birds such as GBH and BcNH require remote, disturbance-free, habitat to nest. Colony locations on islands or wooded peninsulas are not static. Given enough time, the location of a heron colony will probably change. Sometimes this change may be brought on by disturbance, causing a complete colony desertion; however smaller changes may often be the result of habitat loss. This loss is caused by the herons themselves! The trees are slowly killed by the defecated and regurgitated material produced by the herons. As we have seen at Inkerman MBS, this process of a subtle shift in colony location occurs over many years.

The Inkerman colony was first recorded in 1971 with approximately 10 pair of GBH. By 1986 the colony had expanded to 50 nests of GBH and 250 nests of BcNH. By this time a number of the nest supporting trees had been killed. By 2000, a large part of the original colony core which had been forest in 1971 was now standing, dead snags, of spruce with a lush understory of elderberry and raspberry. In 2006, the GBH had expanded into new habitat and the BcNH had deserted the colony; presumably relocating 15 km to the north at Lameque.

In 36 years, the GBH and BcNH colonies have gone from initial establishment, through a long stable period, to colony desertion by the BcNH. The GBH numbers have so far remained stable. This study emphasizes the importance of long term monitoring of heronries and has implications regarding environmental assessments and decisions pertaining to coastal development. Using the history of the Inkerman bird colony as an example, nest counts for colonial nesters, from one or two years, should not solely be

used to make important management decisions. Should little data be available, the potential for habitat and colony change, as witnessed at Inkerman, should be considered.

There are relatively few large heronries along the eastern shore of New Brunswick, and most of these are restricted to a few offshore islands. These coastal areas are under pressure from housing and cottage developments that are increasing at an alarming rate. For birds such as GBH and BcNH the best way to protect the colonies is to leave them alone and give them ample room to develop and if needed, shift or change colony location; recognizing that as habitat recovers the birds may return to a nesting location many decades after desertion. Any human development in the immediate vicinity of a heronry, with a look towards the colony's needs many years into the future, must be approached with caution. Also, as optimal nesting sites are limited, any development within habitats with a high future potential for herons should also be approached with considerable care. Man has the ability to alter the landscape and choose when and where development occurs. The herons have limited choices and sometimes have no place else to go!

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The body of data for the Inkerman heron colony have been collected by a number of observers over many years. Being infinitely familiar with the joys of colonial surveys, including hordes of mosquitoes and the unforgettable experience of having the recent meal of a Great Blue Heron ejected in your direction, we would like to thank the following crew leaders, staff and volunteers for their efforts: Diane Amirault, Andrew Boyne, Eric Brideau, Adam Campbell, H. Chiasson, Roland Chiasson, Don Colpitts, Stephen Flemming, Ross Galbraith, Stephane Hachey, Randy Hicks, Jason Hudson, Lance Laviolette, Larry MacDonnell, Andrew Macfarlane, Matthew Robinson, Al Smith, Royce Steeves, Lee Warren, Kyle Wellband.

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Table 1. Number of Great Blue Heron (GBH) and Black-crowned Night Heron (BcNH) nests within the Inkerman Migratory Bird Sanctuary, New Brunswick, 1971-2006.

Survey Date	BCNH nests	GBH nests	Source/Crew Leader
7 June 1971	present	10+	H. Chiasson, M.N.R.S.[1]
1 June 1972	?	70	H. Chiasson, M.N.R.S.
21 June 1979	?	90	Al Smith (aerial survey)
8 July 1979	?	75	H. Chiasson
1 July 1981	575 - 700 (estimate)	115 (estimate)	Al Smith[2,3] (ground survey)
6 July 1986	250	40	H. Chiasson
13 July 1987	200	50	H. Chiasson M.N.R.S.
9 June 1993	601	81	C. MacKinnon (ground survey)
9 June 1998	383	50	C. MacKinnon (ground survey)
5 June 2000	480	41	C. MacKinnon (ground survey)
31 May – 1 June 2000	(no estimate attempted)	68	A. Boyne (aerial survey)
13 Aug., 2001	280	62	E. Brideau (ground survey)
12 June 2002	405	78	C. MacKinnon (ground survey)
2 June 2005	172[4]	51	C. MacKinnon (ground survey)
7 June 2006	82[5]	53[6]	C. MacKinnon (ground survey)

[1] M.N.R.S. = Maritimes Nest Records Scheme, Canadian Wildlife Service, Sackville.
[2] Surveyors note: "Census was very quick because of the amount of disturbance we seemed to be causing".
[3] Surveyors note: "There are probably upwards to 700 BCNH nests in the colony, the survey should have been done about two weeks earlier".
[4] 172 empty nests recorded and only four adult BcNH observed around the colony. The BCNH are believed to have initiated nest construction early in 2005 then abandoned the colony.
[5] 82 empty nests recorded. No adult BCNH observed. We believe these nests are remnants from 2005.
[6] 53 GBH nests recorded but only 45 were active/occupied.

Table 2. Distribution and number of Great Blue Heron (GBH) and Black-crowned Night Heron (BcNH) nests within the Inkerman Migratory Bird Sanctuary from 1993 to 2006. For the following AREA designations (A - I), see text and Figures 12 – 16.

AREA – SURVEY YEAR	GBH (nests recorded)	BcNH (nests recorded)
A - 1993	81	601
B - 1998	43	383
C - 1998	7	0
D - 2000	39	450
E - 2000	2	30
F - 2002	68	387
G - 2002	10	0
H - 2005	22	73 - abandoned
I - 2005	29	99 - abandoned
H - 2006	18[1]	0[2]
I - 2006	35	0[2]

[1] 18 GBH nests recorded (11 occupied, 7 un-occupied).

[2] 2006 - 82 empty nests recorded (remnants from previous years), no adult BcNH present.

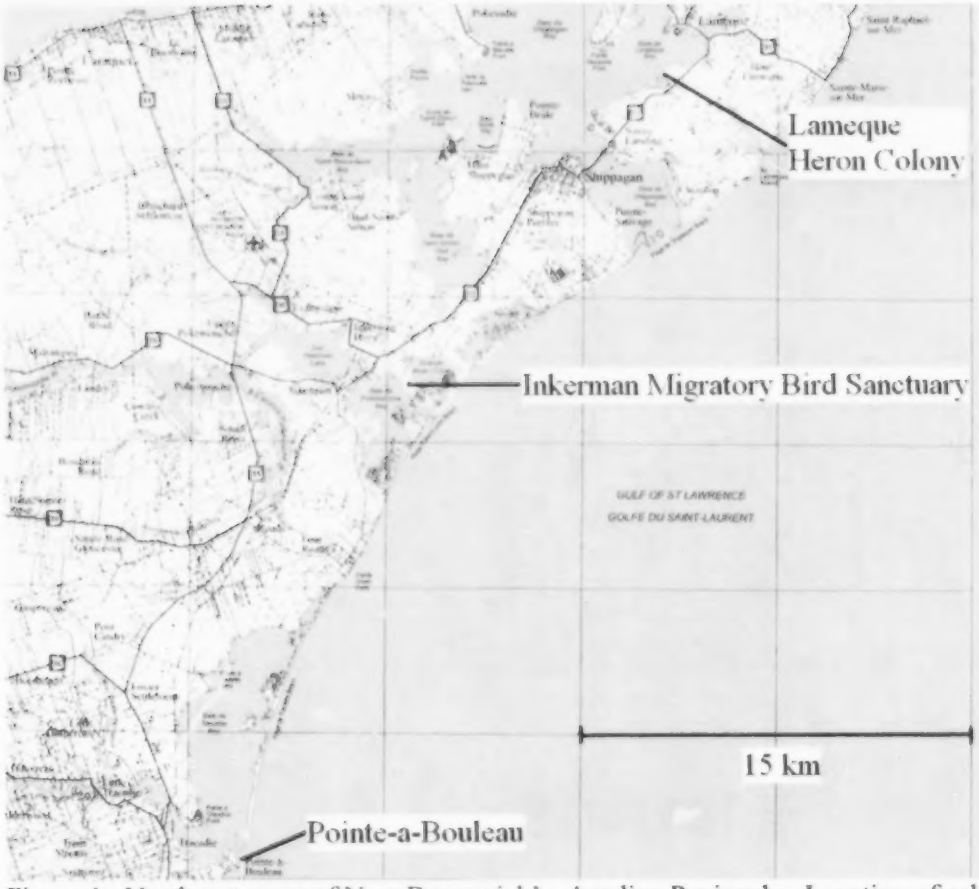

Figure 1. Northeast coast of New Brunswick's, Acadian Peninsula. Location of salient features mentioned in text (New Brunswick Atlas, Second Edition, 1998).

Figure 2. Topographic map, 21 P/10 (Tracadie), of Inkerman Migratory Bird Sanctuary, New Brunswick, (sanctuary location shaded) and the surrounding area (1 km grid squares).

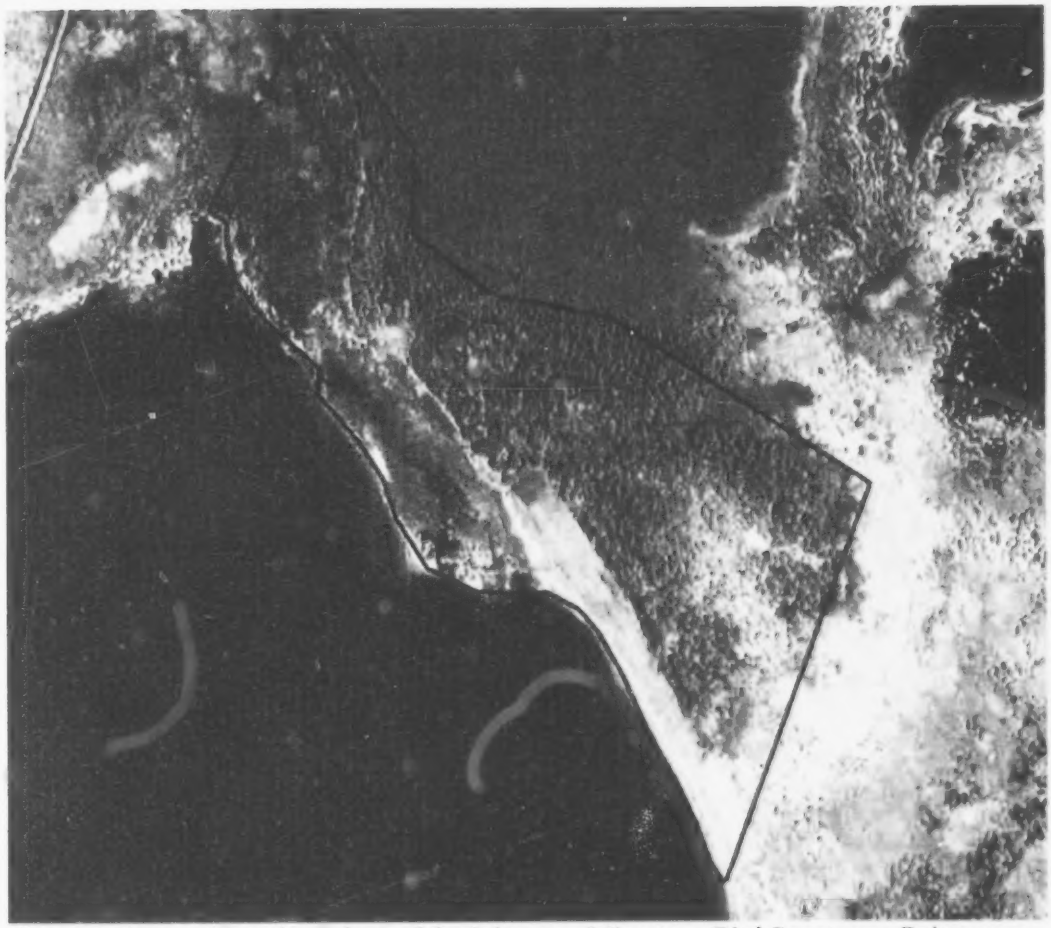

Figure 3. Approximate boundary of the Inkerman Migratory Bird Sanctuary, Pointe aux Rats Musqués, New Brunswick (15.1 ha).

Figure 4. Entrance to the Inkerman Migratory Bird Sanctuary, Pointe aux Rats Musqués, New Brunswick.

Figure 5. Photo of Inkerman Migratory Bird Sanctuary, 9 June, 1998 showing decayed interior of the colony. There are few Great Blue Heron (GBH) nests remaining in the dead spruce (two GBH nests at arrow).

Figure 6. Black-crowned Night Heron nests, Inkerman Migratory Bird Sanctuary, 9 June 1998, in typical nesting habitat of Red Maple, Trembling Aspen and White Birch.

Figure 7. Black-crowned Night Heron nests, Inkerman Migratory Bird Sanctuary, 9 June 1998 in typical nesting habitat of Red Maple, Trembling Aspen and White Birch.

Figure 8. Aerial photograph of Inkerman MBS, Pointe aux Rats Musqués, New Brunswick, 1963, prior to establishment of the GBH and BcNH heron colony. (Aerial photograph No. 6346 – 47).

Figure 9. Aerial photograph of Inkerman MBS, Pointe aux Rats Musqués, New Brunswick, in 1971. Great Blue Heron (10+ nests.) and Black-crowned Night Heron believed present. Colony not visible from the air.
(Aerial photograph No. 71071-173).

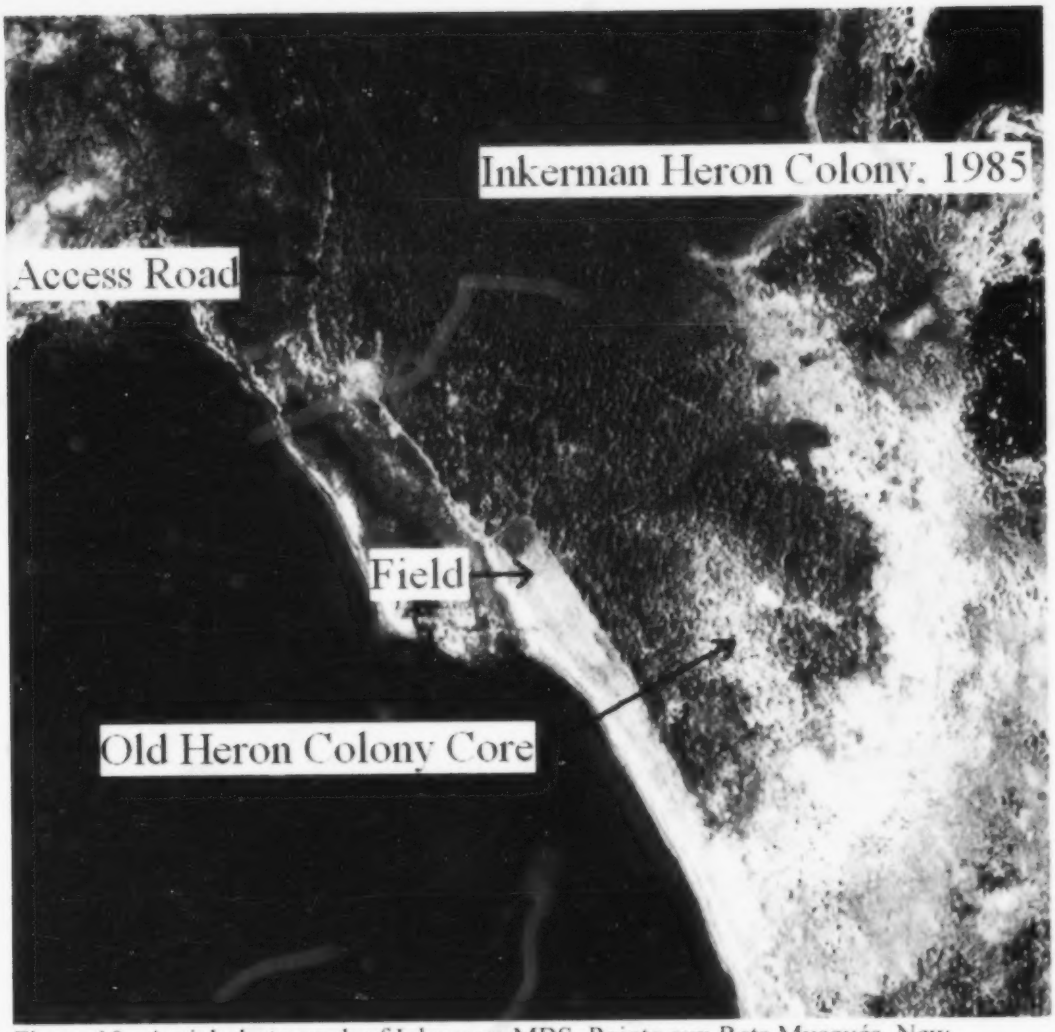

Figure 10. Aerial photograph of Inkerman MBS, Pointe aux Rats Musqués, New Brunswick, in 1985. Great Blue Heron (115 pair) and Black-crowned Night Heron (575 – 700 pair) in 1981 survey. Colony evident in area of dead and dying trees (in area around the old colony core); tree loss is starting to occur.
(Aerial photograph No. DNRE 85512-288).

Figure 11. Aerial photograph of Inkerman MBS, Pointe aux Rats Musqués, New Brunswick, in 2002. Great Blue Heron (41 pair) and Black-crowned Night Heron (480 pair) in 2000 survey. Continued tree nesting of herons has killed most of the trees in the right center of photo. (Aerial photograph No. DNRE 02516 -64).

Figure 12. Aerial photograph of Inkerman MBS showing the extent of the GBH and BcNH colony in 1993. See text for discussion.

Figure 13. Aerial photograph of Inkerman MBS showing the extent of the colony in 1998. See text for discussion.

Figure 14. Aerial photograph of Inkerman MBS showing the extent of the colony in 2000. See text for discussion.

Figure 15. Aerial photograph of Inkerman MBS showing the extent of the colony in 2002. See text for discussion.

Figure 16. Aerial photograph of Inkerman MBS showing the extant of the colony in 2005 and 2006. See text for discussion.

APPENDIX I. Legal description of Inkerman Migratory Bird Sanctuary, 20 October, 1998.

Inkerman Migratory Bird Sanctuary

In the Province of New Brunswick;

In the County of Gloucester;

In the Parish of Inkerman;

All that parcel of land shown as Parcel "A" in Certificate of Title No. 133575 (Plan No. 263-1982), registered in Book No. 803, Pages 580 to 587, in the Registry Office for the County of Gloucester at Bathurst, and being more particularly described as follows:

Commencing at a survey marker at the most northerly corner of said Parcel "A"; thence on an azimuth of 147°46'42", a distance of 86.241 metres to a survey marker; thence on an azimuth of 144°38'19", a distance of 46.673 metres to a survey marker; thence on an azimuth of 146°34'36", a distance of 73.623 metres to a survey marker; thence on an azimuth of 164°44'28", a distance of 77.507 metres to a survey marker; thence on an azimuth of 125°32'18", a distance of 36.707 metres to a survey marker; thence on an azimuth of 103°24'01", a distance of 111.472 metres to a survey marker; thence on an azimuth of 121°00'53", a distance of 121.647 metres to a survey marker; thence on an azimuth of 118°52'56", a distance of 153.068 metres to a survey marker; thence on an azimuth of 198°25'34", a distance of 342.321 metres to a survey marker; thence on an azimuth of 198°25'34", a distance of about 6 metres to the ordinary high water mark of the Pokemouche River; thence northwesterly along the sinuosities of the ordinary high water mark of the Pokemouche River to its intersection with the westerly boundary of said Parcel "A"; thence on an azimuth of 16°31'19", a distance of about 3 metres to a survey marker; thence on an azimuth of 16°31'19", a distance of 210.000 metres to a survey marker; thence on an azimuth of 16°31'19", a distance of 24.770 metres to the point of commencement; said parcel containing about 15.1 hectares.